PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2000-194046

(43)Date of publication of application : 14.07.2000

---

(51)Int.Cl. G03B 17/04
G02B 7/04
G02B 7/08

---

(21)Application number : 11-301143 (71)Applicant : CANON INC

(22)Date of filing : 22.10.1999 (72)Inventor : TAKESHITA SHIGERU

---

(30)Priority
Priority number : 10301486
Priority date : 22.10.1998
Priority country : JP

---

(54) OPTICAL DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To miniaturize an optical system in the case of housing by withdrawing a 1st lens unit in space made free by withdrawing a 2nd lens unit.
SOLUTION: When a mode other than a photographing mode such as a power source turnoff mode or a reproducing mode is selected, a step motor is driven and a third group

lens barrel is moved to a collapsing standby position (S111 and S112). Next, a DC motor is driven to move the lens barrel to a collapsible position, and then the photographing mode is finished (S113 and S114). At the time of starting photographing, a second group lens barrel is extended first, and then the third group lens barrel is driven to be extended to the space made free by extending the second group lens barrel. At the time of collapsing, the third group lens barrel is withdrawn to the collapsible position first, and then the second group lens barrel is driven to be withdrawn to the space made free by withdrawing the third group lens barrel. Thus, a distance between the lens barrels at the time of collapsing is made extremely small while avoiding the collision of the lens barrels, and the optical system in the case of housing is miniaturized.

CLAIMS

[Claim(s)]

[Claim 1]An optical apparatus comprising:

The 1st lens unit that constitutes an optical system.

The 1st motor that drives said 1st lens unit.

The 2nd lens unit provided behind [which constitutes said optical system] said 1st lens unit.

Answer the 2nd motor that drives said 2nd lens unit, and storage directions of said optical system, and said 2nd lens unit is rounded, this 2nd lens unit -- marching in -- a control means which controls said 1st and 2nd motor to round said 1st lens unit to it after said 2nd lens unit leaves said space in a space left.

[Claim 2]The optical apparatus according to claim 1 characterized by forbidding a drive of said 1st motor when it has a position detecting means which detects a reference position of said 2nd lens unit and, as for said control means, said position detecting means cannot detect a reference position of said 2nd lens unit.

[Claim 3]The optical apparatus according to claim 1 or 2 characterized by forbidding a drive of said 2nd motor when it has a position detecting means which detects a reference position of said 2nd lens unit and, as for said control means, said position detecting means cannot detect a reference position of said 2nd lens unit.

[Claim 4]Have the rewritable nonvolatile memory which memorizes information about movement magnitude from said reference position detected by position detecting means which detects a reference position of said 2nd lens unit, and said position detecting means to a stowed position of said 2nd lens unit, and said control means, The optical apparatus according to claim 1 controlling said 2nd motor to round said 2nd lens unit to a stowed position according to said information memorized by said nonvolatile memory.

[Claim 5]The optical apparatus according to claim 4, wherein information about said movement magnitude memorized by said nonvolatile memory is set up for said every optical apparatus.

[Claim 6]The optical apparatus according to claim 1, wherein said 1st lens unit is a lens for variable power.

[Claim 7]The optical apparatus according to claim 1 or 6, wherein said 2nd lens unit is a lens for focus doubling.

[Claim 8]The optical apparatus according to claim 1, wherein said 1st motor is a DC motor.

[Claim 9]The optical apparatus according to claim 1 or 8, wherein said 2nd motor is a

step motor.
[Claim 10]The optical apparatus according to any one of claims 1 to 9, wherein said optical apparatus is a camera.
[Claim 11]The optical apparatus according to any one of claims 1 to 9, wherein said optical apparatus is a lens barrel.
[Claim 12]An optical apparatus comprising:
The 1st lens unit that constitutes an optical system.
The 1st motor that drives said 1st lens unit.
The 2nd lens unit provided behind [which constitutes said optical system] said 1st lens unit.
Answer the 2nd motor that drives said 2nd lens unit, and storage directions of said optical system, and said 2nd lens unit is rounded, this 2nd lens unit -- marching in -- a control means which controls said 1st and 2nd motor to round said 1st lens unit to it after said 2nd lens unit leaves said space in a space to which said 1st lens vacated does not serve as a movement region in condition of use.

[Claim 13]An optical apparatus comprising:
The 1st lens unit that constitutes an optical system.
The 1st motor that drives said 1st lens unit.
The 2nd lens unit provided behind [which constitutes said optical system] said 1st lens unit.
Answer the 2nd motor that drives said 2nd lens unit, and delivery directions of said optical system, and it lets out said 1st lens unit, A control means which controls said 1st and 2nd motor to let out said 2nd lens unit to it after said 1st lens unit leaves said space in a space left by delivery of this 1st lens unit.

[Claim 14]The optical apparatus according to claim 13 characterized by forbidding a drive of said 1st motor when it has a position detecting means which detects a reference position of said 2nd lens unit and, as for said control means, said position detecting means cannot detect a reference position of said 2nd lens unit.
[Claim 15]The optical apparatus according to claim 13 or 14 characterized by forbidding a drive of said 2nd motor when it has a position detecting means which detects a reference position of said 2nd lens unit and, as for said control means, said position detecting means cannot detect a reference position of said 2nd lens unit.
[Claim 16]The optical apparatus according to claim 13, wherein said 1st lens unit is a lens for variable power.

[Claim 17]The optical apparatus according to claim 13 or 16, wherein said 2nd lens unit is a lens for focus doubling.
[Claim 18]The optical apparatus according to claim 13, wherein said 1st motor is a DC motor.
[Claim 19]The optical apparatus according to claim 13 or 18, wherein said 2nd motor is a step motor.
[Claim 20]The optical apparatus according to any one of claims 13 to 19, wherein said optical apparatus is a camera.
[Claim 21]The optical apparatus according to any one of claims 13 to 19, wherein said optical apparatus is a lens barrel.
[Claim 22]An optical apparatus comprising:
The 1st lens unit that constitutes an optical system.
The 1st motor that drives said 1st lens unit.
The 2nd lens unit provided behind [which constitutes said optical system] said 1st lens unit.
Answer the 2nd motor that drives said 2nd lens unit, and delivery directions of said optical system, and it lets out said 1st lens unit, A control means which controls said 1st and 2nd motor to let out said 2nd lens unit to it after said 1st lens unit leaves said space in a space to which said 1st lens vacated by delivery of this 1st lens unit does not serve as a movement region in condition of use.

2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates an optical system to optical apparatuses, such as a camera movable to a using position and a stowed position.
[0002]
[Description of the Prior Art]In the camera which moves two or more lens groups to an optical axis direction, and performs variable power operation and focusing operation conventionally, at the time of un-taking a photograph, said lens group is stored in a camera body, it is considered as a collapsed state, and what takes a gestalt suitable for carrying is known. Conventionally, using actuators, such as a DC motor, for example, it is different from this to focusing operation, actuators, such as a step motor, are formed, and it is constituted by the drive to a collapsing position at variable power operation at such a drive so that the actuator of said variable power operation may be driven further and may be stored.
[0003]The lens system of the rear focus type which has arranged the lens for focuses back rather than the lens for variable power is adopted as this kind of lens barrel.
[0004]
[Problem(s) to be Solved by the Invention]However, in the above-mentioned conventional camera, since there was a lens for focuses even if it made the lens for variable power collapse, the space for the lens driving range for the focuses could not be collapsed at least, but there was a problem that the miniaturization by collapsing could not be attained enough.
[0005]The purpose of this invention tends to provide the optical apparatus which can attain enough the miniaturization of the optical system at the time of storage.
[0006]
[Means for Solving the Problem]To achieve the above objects, a thing this invention is characterized by that comprises the following and which is used as an optical apparatus.
The 1st lens unit that constitutes an optical system.
The 1st motor that drives said 1st lens unit.

The 2nd lens unit provided behind [which constitutes said optical system] said 1st lens unit.
Answer the 2nd motor that drives said 2nd lens unit, and storage directions of said optical system, and said 2nd lens unit is rounded, this 2nd lens unit -- marching in -- a control means which controls said 1st and 2nd motor to round said 1st lens unit to it after said 2nd lens unit leaves said space in a space left.

[0007]A thing this invention is characterized by that comprises the following and which is used as an optical apparatus.
The 1st lens unit that constitutes an optical system.
The 1st motor that drives said 1st lens unit.
The 2nd lens unit provided behind [which constitutes said optical system] said 1st lens unit.
Answer the 2nd motor that drives said 2nd lens unit, and storage directions of said optical system, and said 2nd lens unit is rounded, this 2nd lens unit -- marching in -- a control means which controls said 1st and 2nd motor to round said 1st lens unit to it after said 2nd lens unit leaves said space in a space to which said 1st lens vacated does not serve as a movement region in condition of use.

[0008]A thing this invention is characterized by that comprises the following and which is used as an optical apparatus.
The 1st lens unit that constitutes an optical system.
The 1st motor that drives said 1st lens unit.
The 2nd lens unit provided behind [which constitutes said optical system] said 1st lens unit.
Answer the 2nd motor that drives said 2nd lens unit, and delivery directions of said optical system, and it lets out said 1st lens unit, A control means which controls said 1st and 2nd motor to let out said 2nd lens unit to it after said 1st lens unit leaves said space in a space left by delivery of this 1st lens unit.

[0009]A thing this invention is characterized by that comprises the following and which is used as an optical apparatus.
The 1st lens unit that constitutes an optical system.
The 1st motor that drives said 1st lens unit.
The 2nd lens unit provided behind [which constitutes said optical system] said 1st lens unit.

Answer the 2nd motor that drives said 2nd lens unit, and delivery directions of said optical system, and it lets out said 1st lens unit, A control means which controls said 1st and 2nd motor to let out said 2nd lens unit to it after said 1st lens unit leaves said space in a space to which said 2nd lens vacated by delivery of this 1st lens unit does not serve as a movement region in condition of use.

[0010]

[Embodiment of the Invention]Hereafter, an embodiment of the invention is described with reference to drawings.

[0011]The exploded perspective view of a body tube portion showing the embodiment of the camera with which drawing 1 carried out this invention and drawing 2 - 4 are central sectional views, and, as for a collapsing position and drawing 3, drawing 2 shows the tele position, as for a wide position and drawing 4.

[0012]1 is a base which is a base of a body tube unit, and forms the structure of a body tube unit with the fixing cylinder 2 fixed to the front end part by a screw stop. 3 is 1 group body tube and holds the lenses 4, 5, and 6. The three follower pins 7 which have a taper part at a tip are pressed fit in the peripheral side face, and the cap 8 is being fixed to the front face by adhesion.

[0013]9 is 2 group body tube, holds the lenses 10, 11, and 12 and is held in one by adhesion or other means at the diaphragm cope plate 14 of the diaphragm unit 13.

[0014]Drawing 5 is an exploded perspective view of the diaphragm unit 13, while the two follower parts 14a which have a taper part at a tip are formed in the peripheral part of the diaphragm cope plate 14 in one, the one movable movable follower 81 is formed in shaft orientations, and a total of three followers are arranged at division into equal parts.

[0015]Press energizing of the movable follower 81 is carried out by the flat spring 82 in the rear end part, and by this, it makes a mechanical crevice put aside and maintains accuracy. The movable follower 81 is formed in the position which becomes the upper part most when a camera is set to a regular position among three followers here, it will put aside by it, a direction and a gravity direction will be abbreviated-in agreement, and small energizing force is enough -- it can put aside and an effect can be acquired, and driving load is mitigable while a space-saving effect is acquired.

[0016]83 is the coil wound around the bobbin about, and the magnetic flux generated by energizing to this makes the arm 86 and the magnet 87 formed in one generate magnetic torque via the yokes 84 and 85.

[0017]88 and 89 are diaphragm blades, and it is shown to linear shape oblong hole part

88 b-d provided in each, and 89 b-d to them at the axes 14b-14e of the cope plate 14, and they are provided so that a slide is possible. The two shanks 86a and 86b provided in the arm of the arm 86 are inserted in the holes 88a and 89a of the shuttlecocks 88 and 89.

[0018]90 is a cap, it pinches said coil 83 and the yokes 84 and 85 between the cope plates 14, fixes to it, and holds the arm 86 (and magnet 87) pivotable. 91 is a case which prevents omission of the shuttlecocks 88 and 89.

[0019]This diaphragm unit 13 is arranged at the inner circumference of the below-mentioned advance guide pipe 49. By therefore, the thing for which it separates into the both sides of an optic axis, the coil 83 which needs a fixed space, and the magnet 86 are arranged in a unit, and especially the longitudinal direction is coincided with the sliding direction of said shuttlecocks 88 and 89. It was considered as arrangement suitable for the inside of tubed parts like said advance guide pipe, and has contributed to the miniaturization of a device.

[0020]15 is 3 group body tube holding the lens 16, and while showing around at the guide bars 17 and 18, the position of shaft orientations is regulated by the nut 19 which has the female screw pinched to the arm, it is rounded with the hauling spring 20, and is put aside and made into the direction. The projection 15a of 3 group body tube 15 has fitted into the slit part 19a provided in the nut 19, and rotation is regulated (drawing 7).

[0021]21 is the magnet 22 and the screw provided in one, and has a female screw portion of said nut 19, and a male screw part to screw. 23 is the bearing metal pressed fit in the base 1, and the end part of said screw 21 has fitted in pivotable.

[0022]The coil 27 which 24 is a step motor for driving said 3 group body tube, and was wound around the yokes 25 and 26 and bobbin of the couple about, 2 sets is arranged so that linear shape may be countered, so that said magnet 22 may be inserted, and it is being fixed by carrying out the screw stop of the yoke plate 28 on the base 1 (drawing 6).

[0023]In drawing 7, 29 is the photo interrupter fixed to the base 1, and the slit plate 30 fixed to 3 group body tube 15 in one is arranged at the position which can move to the slit part of said photo interrupter. 31 is the cap fixed to the base 1, fixes the tip side of the guide bars 17 and 18, and holds the screw 21 pivotable.

[0024]32 is an image sensor and fixed holding is carried out to the retainer board 33 by which screw stop immobilization is carried out at the base 1 by adhesion etc. 34 is FUREKI and supplies the picture signal by which photoelectric conversion was carried out to the below-mentioned digital disposal circuit. The rubber for protection against

dust and 36 are low pass filters (LPF), and 35 is being fixed to both the bases 1 by adhesion etc.

[0025]The driving ring 37 has fitted into the peripheral part of said fixing cylinder 2 pivotable. In the peripheral part of the driving ring 37, it has the geared part 37a in part. 38 is a DC motor, and as shown in drawing 8, the pinion gear 39 is formed in the output shaft by press fit etc. in one. The driving force of the motor 38 is transmitted to the geared part 37a of said driving ring 37 through the gears 40, 41, 42, 43, 44, and 45 sequentially from said gear 39. These gears 40–45 are stored by the gearboxes 46 and 47, and are being fixed to the base 1. Said motor 38 is also being fixed to said gearbox 46.

[0026]The moving cam ring 48 fitted into the inner periphery of said fixing cylinder 2, and the advance guide pipe 49 has fitted into the inner circumference.

[0027]The follower pins 51 which have the drive pin 50 and a taper part in the peripheral part of the moving cam ring 48 stand erect in three-piece division into equal parts, and the drive pin 50 has fitted into the slot 37b which penetrated the hole 2a of the fixing cylinder 2, and was established in the inner circumference side of the driving ring 37. The follower pins 51 are in slide contact with taper cam-groove 2b with which the tip taper part was provided in the inner circumference of the fixing cylinder 2. Drawing 9 is an inner surface development view explaining the above.

[0028]Drawing 10 is an inner surface development view of the moving cam ring 48, and the follower 14a (or 81) formed in the follower 7 and the diaphragm cope plate 14 which the taper cam grooves 48a and 48b were established in the inner circumference, and were formed in said 1 group body tube 3, respectively is in slide contact.

[0029]Simultaneously, it has fitted into the straight gashes 49a and 49b of said advance guide pipe 49, the position of the hand of cut is regulated, and the lateral portion of each follower regulates rotation of 1 group body tube 3 and the diaphragm unit 13, and permits rectilinear-propagation movement.

[0030]While the front-sides height 49c of the peripheral part of the advance guide pipe 49 is in contact with the slot 48c of the inner circumference of the moving cam ring 48, The flange 49d of a rear end part is in contact with the end of the moving cam ring 48, and, as for the advance guide pipe 49, relative movement to an optical axis direction is regulated by this to the moving cam ring 48. Simultaneously, the back side impact erection 49e has fitted into the linear groove part 2c of the inner circumference of the fixing cylinder 2 so that rectilinear propagation is possible, and movement of the hand of cut is regulated.

[0031]the height to which the step motor 24 put LPF36 on the image sensor 32 in this

embodiment as shown in drawing 1 - 6 -- abbreviated -- moreover along with one of them, it is developed by linear shape, and the screw 21 and the magnet 22 are arranged near [the] the center of one side at the same height. This can constitute 3 group body tube 15 thinly in plate-like, and it approaches, tubed parts, such as said moving cam ring 48 and the advance guide pipe 49, can be arranged, and the miniaturization of a device can be attained.

[0032]By what the longitudinal direction of the above-mentioned diaphragm unit 13 and the longitudinal direction of said step motor 24 are coincided for. The guide bars 17 and 18 and the screw 21 can be arranged to the space which is the circumference of said diaphragm unit and as for which the inside of said moving cam ring 48 was vacant, and by this, as shown in drawing 2, the overall length of the device at the time of collapsing can be shortened.

[0033]In drawing 1 - 4, 52 is a cap, and it has the rail sections 52a and 52b which guide the below-mentioned barrier 54 in the front face while it holds the sheet 53 for protection against dust between the fixing cylinders 2. The sheet 55 for protection against dust is inserted also in the slot 48c of the moving cam ring 48.

[0034]56 is a linear sensor and is fixed to the base 1 by a screw stop etc. The circuitry is a variable resister as drawing 11 (a) shows, and if predetermined voltage is impressed between the terminals 1 and 3, the output of the terminal 2 will change linearly, as drawing 11 (b) shows, because the slider 56a slides. 57 is a lever which pinches said slider 56a to the arm 57a, and is guided at the guide bar 58. The lever 57 had the follower part 57b which has a taper part at the tip, and the side has fitted into the slot 1a of the base 1. 59 is a spring which puts aside and carries out said lever. Drawing 12 is the figure which looked at this portion from the transverse plane.

[0035]Drawing 13 is an outside development view of said driving ring 37, and the follower part 57b of said lever is in slide contact with the rectilinear cam slot 37c. 37d and 38e are the taper cam grooves for carrying out the zooming drive of the unillustrated finder lens, The follower part provided in [60 / a compensator lens (un-illustrating)] one and 61 are the follower parts provided in the variator lens (un-illustrating) in one, and are in slide contact with said cam grooves 37d and 37e, respectively.

[0036]In drawing 1 and drawing 14, the barrier 54 is supported pivotable focusing on the axis 63 which stood erect at the barrier base 62, was hung on the hooking portion 54a, closes, with the spring 64, is seen from the device front and energized clockwise. 65 is a barrier driving lever, and it is supported pivotable focusing on the axis 66 which stood erect at the barrier base 62, and opens to the hooking portion 65a, the spring 67

is hung, and it is energized clockwise. Here, the energizing force of the two above-mentioned springs is set up like "the closing spring 64<< difference spring 67." The axis 68 stands erect in the position corresponding to the one side face of the barrier 54 at the end of the barrier driving lever 65. 69 is the leaf switch formed by integral moulding, and screw stop immobilization is carried out at the barrier base 62. Screw stop immobilization of the barrier base 62 is carried out at the base 1.

[0037]Drawing 14 (a) is a figure showing the state where the barrier closed, and the step 37f of the driving ring 37 has stopped, where it opened by pressing to the bent part 65b, it resisted the energizing force of the spring 67 and said barrier driving lever 65 is rotated in the direction of the total at half:00. The barrier 54 closes, according to the energizing force of the spring 64, it rotates to a closing direction and the bent part 54b has become a closing state in contact with the stopper part 2d of the fixing cylinder 2.

[0038]Drawing 15 is a block diagram showing an electric combination of the camera which carried out this invention. The lens barrel 71 is explained above and has given the same number as the above to the component included in the inside of the inside of a figure.

[0039]The picture signal by which photoelectric conversion was carried out with the image sensor 32 is recorded on the memories 73, such as a card medium, after predetermined processings, such as convert colors and gamma processing, are performed in the digital disposal circuit 72. The control section 74 is controlling the whole camera, it controls the step motor 24, DC motor 38, and the diaphragm unit 13, supervising outputs, such as linear sensor [inside a body tube] 56, photo interrupter 29, and leaf SW69, and is also performing the above-mentioned signal processing and control of the memory.

[0040]75 is the nonvolatile memory in which elimination and record are possible electrically, and EEPROM etc. are used, for example.

[0041]76 is a mode dial switch and can carry out switch setting of each functional mode, such as power OFF, photographing mode, reproduction mode, and PC connection mode.

[0042]The above composition explains the operation below.

[0043]As it said previously that DC motor 38 is driven, the driving ring 37 rotates via the gears 39-45 (drawing 8). Since the drive pin 50 of the moving cam ring 48 which penetrated the hole 2a of the fixing cylinder 2 fits into the linear shape slot 37b formed in the inner periphery of the driving ring 37 along the optical axis direction, the moving cam ring 48 rotates via the drive pin 50 by rotation of the driving ring 37, but.

Since the follower pins 51 of the moving cam ring 48 have fitted into cam-groove 2b of the fixing cylinder 2, the moving cam ring 48 moves also to an optical axis direction along with cam 2b of the fixing cylinder 2 (drawing 9).

[0044]If the moving cam ring 48 moves to an optical axis direction, the advance guide pipe 49 will also move to an optical axis direction at one, but it moves only to an optical axis direction, without rotating, since the height 49e of the periphery is regulated by the fixing cylinder slot 2c.

[0045]Rotation of the moving cam ring 48 will move relatively to an optical axis direction 2 group body tube 9 fixed to 1 group body tube 3 and the diaphragm unit 13 according to the lift of the cams 48a and 48b of the moving cam ring 48 along the slots 49a and 49b of an advance guide pipe, respectively (drawing 10).

[0046]Drawing 16 is the figure for which only the locus of the cam part was extracted, and, as for the cam of the fixing cylinder 2, and (b), 1 group body tube cam of the moving cam ring 48 and (c) of (a) are 2 group cams of the moving cam ring 48. (d) is the sum of (a) and (b) in the moving track of 1 group body tube, and (e) becomes (a) and the sum of (c) by the moving track of 2 group body tube.

[0047]The flat [to the position which a tele position and S are collapsing positions (stowed position), and a wide position and T show to each cam by B from the collapsing position S] W [of a horizontal axis] field is provided. In this way, the drive of DC motor 38 performs change (S-W) of a collapsing position and a photographing feasible position, and zooming operation (W-T) in a photographing area (using position).

[0048]If the driving ring 37 rotates, like the above-mentioned, an unillustrated finder lens will move to an optical axis direction along with the cams 37d and 37e via the followers 60 and 61, and will be interlocked with the zooming operation of the above-mentioned body tube.

[0049]Simultaneously, the lever 57 moves to an optical axis direction along with the cam 37c, displaces the slider 56a of the linear sensor 56, and changes the output like drawing 11 (b). A zoom position is detectable one by one by detecting this output.

[0050]Like drawing 16 (d), 1 group body tube 3 is drawing the locus which turns reciprocation moving of a convex on an image side between the wide position W - the tele position T. Then, by using between the wide position W - the tele position T as a non-line type cam, all of the three above-mentioned cams can suppress the inclination of each cam low, and can aim at mitigation of driving load. the both sides of 1 group cams of the moving cam ring 48 which show (b) of the cam of the fixing cylinder 2 shown in (a) of drawing 16, and drawing 16 -- collapsing - by providing so that it may have the maximal value while it is wide. Said two cams (a and b) can be

made to distribute the delivery quantity of 1 group body tube 3 now, the overall length of the fixing cylinder 2 and the moving cam ring 48 could be shortened, and the miniaturization of a device is realized.

[0051]As mentioned above, as shown in (a) of drawing 14, the step 37f has stopped the barrier driving lever 65b at the time of collapsing, but the driving ring 37. If the driving ring 37 rotates, the above-mentioned stop is canceled in connection with it, it will rotate clockwise according to the energizing force of the difference spring 67, and the barrier driving lever 65 will press the side of the barrier 54 via the axis 68.

[0052]It closes like the above-mentioned, and since the energizing force of the spring 64 is weaker than the energizing force of the difference spring 67, the barrier 54 rotates in the direction of the total at half:00, and will be in the difference state shown in drawing 14 (b). At this time, the bending part 54b of the barrier 54 will press the section 69a of the leaf switch 69, and a switch will be in an ON state. The switching action of such barrier 54 is set up complete in a flat cam [which is shown in S-B of above-mentioned drawing 16 / each] field.

[0053]A drive of the step motor 24 will rotate the screw 21 via the magnet 22. Since it is regulated by the projection 15a of 3 group body tube 15 like the above-mentioned, it moves to an optical axis direction, and 3 group body tube 15 also follows this, and moves to an optical axis direction, and the nut 19 performs a focus. Within the limits of the operation strokes of 3 group body tube 15, the slit plate 30 invades or shunts to the slit part of the photo interrupter 29, and changes that output, and the counter of the step motor 24 is reset at this time.

[0054]Drawing 17 is a flow chart which shows operation of a camera, and (a) shows the time of starting. If photographing mode is chosen with the mode dial 76 (s101), a control section will distinguish whether the zooming positions of a body tube unit are collapsing positions, or it is a photographing feasible position of a wide - call from the output of a linear sensor (s102).

[0055]When a position is a wide - call, it progresses to s107. When it is in a collapsing position, the specified quantity drive of DC motor 38 is carried out in the delivery direction by s103. This specified quantity is the quantity corresponding to S-B in above-mentioned drawing 16, and a zooming drive is once suspended here and it is detected whether the leaf switch 69 is an ON state (s104). When a switch is OFF, it considers that the error occurred, and processes [displaying warning etc. and], and the zooming drive beyond it and the drive of the subsequent step motor 29 are not performed (s105), but if it is one, a zooming drive will be performed further, and it is ****** (s106) about a body tube to a wide position.

[0056]If the delivery of the body tube to the wide position by a zooming drive is completed, next, the step motor 24 will be driven in the switching position direction of the photo interrupter 29 (s107). suspending the drive of the step motor 24 in the position, if the change rate of the photo interrupter 29 is detectable -- a count -- resetting (s108), when it cannot detect for a certain reason, Warning is displayed noting that an error occurs, and the drive of the step motor 24 beyond it and the drive of zoom are forbidden simultaneously (s109). If a reset action is completed, the step motor 24 will be driven to the position in readiness which puts focusing operation into operation further, and it will be in the waiting state which can be photoed (s110).

[0057]Drawing 17 (b) shows the time of the end of photographing mode. With the mode dial 76, if chosen except photographing modes, such as power OFF and reproduction mode (s111), the step motor 24 will be driven first and 3 group body tube 15 will be moved to a collapsing position in readiness (collapsing completion position) (s112). This position is beforehand adjusted according to a camera individual in a manufacturing process, and is stored in the nonvolatile memory 75 as an amount of counts from the position by which the counter of said step motor 24 was reset. Next, DC motor 38 is driven, a body tube is moved to a collapsing position (s113), and photographing mode is ended (s114).

[0058]It is as the state at this time showing drawing 2 like the above-mentioned. In this embodiment, as shown in drawing 2 - 4, the driving stroke of 3 group body tube 15 in a photographing feasible position (condition of use) has lapped with the collapsing position where that of 2 group body tube 9 shown in drawing 2 does not serve as a movement region in a photographing feasible position.

[0059]Previously 2 group body tube 9 as mentioned above at the time of a photographing start And [a delivery, after that], The delivery drive of 3 group body tube 15 is performed to the space vacant by the delivery of 2 group body tube 9, rounding 3 group body tube 15 to a collapsing position previously at the time of collapsing -- after that and 3 group body tube 15 -- marching in, since it controls to drive by 2 group body tube 9 marching into the vacant space, The interval between the body tubes at the time of collapsing can be made very small, avoiding the collision of these body tubes, and the miniaturization of the optical system at the time of storage can be attained.

[0060]Simultaneously, when fault occurs in the reset action of 3 group body tube 15, damage to apparatus can be avoided by forbidding the drive of DC motor 38, and the drive of the step motor 24.

[0061]Although the position from which a photo interrupter usually changes has much

each variation, it is memorizing a collapsing position in readiness in a memory as mentioned above, and it can store at a very small interval, avoiding the collision to the base 1 of 3 group body tube 15.

[0062](Correspondence of an invention and an embodiment) 2 group body tube 9 in an above embodiment to the 1st lens unit of this invention. In DC motor 38, 3 group body tube 15 on the 1st motor of this invention to the 2nd lens unit of this invention. the step motor 24 -- the 2nd motor of this invention -- the control section 74 is equivalent to the control means of this invention, the photo interrupter 29 is equivalent to the position detecting means of this invention, and the nonvolatile memory 75 is equivalent to the nonvolatile memory of this invention, respectively.

[0063]Although the above is the correspondence relation between each composition of this invention, and each composition of an embodiment, if this invention is the composition that the function which it is not restricted to the composition of these embodiments and shown by the claim, or the function which the composition of an embodiment has can be attained, it cannot be overemphasized that it may be what kind of thing.

[0064]It may be made for this invention to combine the above embodiment and modifications, or those technical elements if needed.

[0065]This invention Cameras of various gestalten, such as a single-lens reflex camera, a lens shutter camera, and a video camera, Furthermore, it is applicable also to optical instruments other than a camera, other devices, and those camera, optical instrument and other devices, the device further applied to these cameras, an optical instrument, or other devices or the element which constitutes these further.

[0066]The whole or a part of composition of a claim or an embodiment of this invention is like the element which constitutes a device with other devices so that may join together so that may form one device.

[0067]

[Effect of the Invention]As explained above, according to this invention, the optical apparatus which can attain enough the miniaturization of the optical system at the time of storage can be provided.

2.**** shows the word which can not be translated.

3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1]The exploded perspective view of the body tube portion of a camera which carried out this invention.

[Drawing 2]The central sectional view of the body tube of drawing 1 (collapsing position).

[Drawing 3]The central sectional view of the body tube of drawing 1 (wide position).

[Drawing 4]The central sectional view of the body tube of drawing 1 (tele position).

[Drawing 5]The exploded perspective view of the diaphragm unit of drawing 1.

[Drawing 6]The exploded perspective view of the step motor unit of drawing 1.

[Drawing 7]The front view of 3 group body tube actuator of drawing 1.

[Drawing 8]The figure showing the zoom driving gear sequence of drawing 1.

[Drawing 9]The inner surface development view of the fixing cylinder of drawing 1.

[Drawing 10]The inner surface development view of the moving cam ring of drawing 1.

[Drawing 11]The characteristic figure of the linear sensor of drawing 1.

[Drawing 12]The front view of the linear sensor circumference of drawing 1.

[Drawing 13]The outside development view of the driving ring of drawing 1.

[Drawing 14]The barrier opening-and-closing mechanism explanatory view of drawing 1.

[Drawing 15]The block diagram showing the electric constitution of the camera of drawing 1.

[Drawing 16]The figure explaining the cam of drawing 1, and the locus of a body tube.

[Drawing 17]The flow chart which shows the driving sequence of the body tube of drawing 1.

[Description of Notations]

1 Base

2 Fixing cylinder

3 1 group body tube

9 2 group body tube

13 Diaphragm unit

15 3 group body tube

24 Step motor unit

32 Image sensor

37 Driving ring

38 DC motor

48 Moving cam ring

49 Advance guide pipe

54 Barrier

56 Linear sensor